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Profiles in Cardiology

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Heinrich Ewald Hering and the Carotid Sinus Reflex

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Heinrich Ewald Hering (1866–1948) (Fig. 1) was the son of Ewald Hering (1834–1918), a prominent physiologist and the successor of Carl Ludwig both at the "Josephinum" in Vienna and at the University of Leipzig.[1] The "young Hering" was born in Vienna, started his career in physiology in Prague, and was appointed professor and chairman of normal and pathologic physiology at the University of Cologne, Germany, in 1913.[2] One of his research associates, Bruno Kisch (1890–1966), was instrumental in the foundation of both the German Society for Heart and Circulation Research, with Hering as the first president,[3] and of the American College of Cardiology after his emigration to the U.S. in 1938. Another associate was Eberhard Koch (1892–1955), to whom Heinrich Ewald Hering assigned the task of investigating the clinical aspect of the carotid sinus reflex. Hering was also interested in the elucidation of the origin of excitation and of the conduction of the electrical impulse through the heart. He died in 1948 at the age of 83.

In 1905, Hering was inspired by the self-experiment of Johann Nepomuk Czermak to do research in the cardiovascular field.[4] Czermak (1828–1873) had been able to induce a negative chronotropic effect by applying pressure on his right vagal nerve ("Vagusdruckversuch").[5,6] Hering observed that a very soft pressure applied to the carotid sinus also elicited a negative chronotropic effect.[4] He therefore concluded that Czermak had not directly stimulated the efferent nerve, but rather had elicited the carotid sinus reflex by stimulating the afferent sinus nerve. In his anatomical studies in 1924, Hering had discovered that the receptors were located in the carotid sinus. He summarized his experimental data in a monograph.[7]

In this monograph he published the results of numerous experiments, beginning with February 26, 1924 (Fig. 2), that he had performed on dogs, which appeared to be very suitable for the purpose. Electrical stimulation of the carotid sinus and of the carotid sinus nerve led to an effect similar to the exertion of pressure on the carotid sinus from the outside by a clamp. Furthermore, elevation of pressure from inside the carotid sinus produced a blood pressure-lowering effect. Particular emphasis was placed on the contribution and interaction of the reflexes elicited from the aorta and the carotid sinus. He claimed credit for the discovery of both the cardiac reflex (negative chronotropy) and of the vascular reflex (vasodilatation) originating from the carotid sinus. Apart from the detailed description and discussion of his animal experiments, Hering also dealt with observations in humans, particularly those made by E. Koch.[7]

Heinrich Ewald Hering was not the first to work on the baroreceptor reflex; Elias Cyon and Carl Ludwig had discovered an essential element of it almost 60 years earlier.[8] They had shown that the depressor nerve was adjacent to but separate from the vagosympathetic trunks in the neck of the rabbit. Furthermore, electrical stimulation of the central end of the cut depressor nerve induced a reduction of blood pressure measured in the carotid artery and a decrease in heart rate. Electrical stimulation of the peripheral end of the depressor nerve had no effect. It was noted that there was a concomitant decline in heart rate and blood pressure, but no causal relationship. Later it was shown that the reflex hypotension still occurred when reflex bradycardia was abolished by the administration of atropine.

Cyon and Ludwig concluded that there are receptors located in the heart from which information is propagated to the brain, that in turn influences the vascular tone via the vagus nerve.[8] The assumptions made in this study were wrong, but the observations were correct, and the conclusions partly correct. Although the origin of the depressor nerve was anatomically located at the aorta, the authors concluded that the origin

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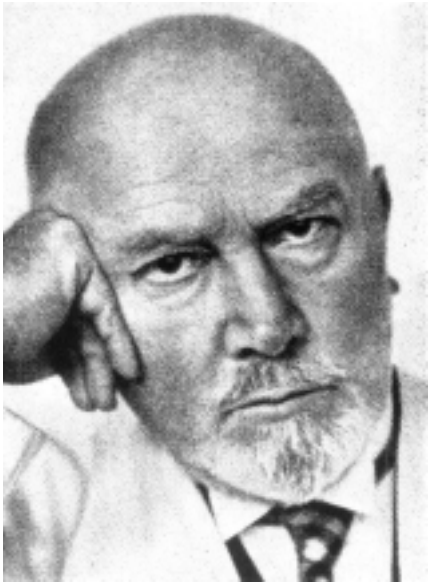

FIG. 1 Heinrich Ewald Hering (1886–1948). Reprinted from Ref. No. 2 with permission.

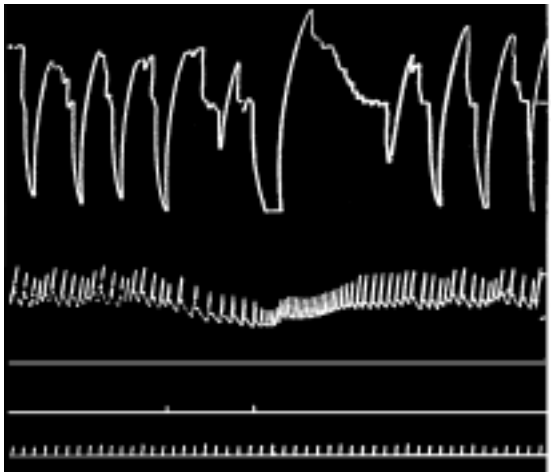

FIG. 2 Original recording of the result obtained in the first experiment in a dog by squeezing the right carotid sinus with a clamp between the two marks on the second tracing from bottom. Prior to this intervention, both common carotid arteries had been closed by clamps. Upper recording: respiration; second recording from above: blood pressure. Reprinted from Ref. No. 7 (Fig. 3) with permission.

of the reflex is the heart. They speculated that cardiac overload and failure may elicit, via the depressor nerve, a decline in heart rate and a reduction in total peripheral resistance so that the left ventricle becomes unloaded. What remained unresolved and puzzled the authors was the result that direct stimulation of the heart increased heart rate, while stimulation of the depressor nerve, which had to be considered afferent, resulted in a decrease in heart rate.

The publication in which Cyon and Ludwig described the baroreceptor reflex[8] was one of the rare instances in which Ludwig functioned as co-author; usually, the young scientists who had done the actual experimental work were the sole authors.[9] This may indicate that Carl Ludwig was particulary interested in the subject and envisioned the significance of this reflex for blood pressure control.

It is interesting that Heinrich Ewald Hering was mainly concerned with the "Vagusdruckversuch" of Czermak, which was the starting point for his studies,[5] and not so much with the reflex first observed and published by Cyon and Ludwig.[8] Hering criticized the term "depressor nerve" used by Ludwig as a misnomer that did not describe its function correctly, since the depressing effect was observed only during artificial stimulation of the nerve.[6] He rather preferred the term "Blutdruckzügler" to designate its role in blood pressure control and regulation.

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